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J. Anat. (2007) 210, p641 doi: 10.1111/j.1469-7580.2007.00740.x

INTRODUCTION

Symposium on 'Live cell imaging of neuronal and glial signalling'

In July 2006 the Institute of Biomedical and Biomolecular Sciences at the University of Portsmouth hosted a symposium on 'Live cell imaging of neuronal and glial signalling', in conjunction with the Anatomical Society of Great Britain and Ireland. The symposium was organized by Professor Arthur Butt and here we present articles arising from the presentations given in the symposium. The six papers presented here address the issue of how live cell imaging techniques have helped transform the prevailing neurocentric view of information processing in the central nervous system (CNS) to include glial cells. In the past, glia were considered to be passive structural elements, but the development of calcium-sensitive dyes and transgenic mice in which specific glial cell types express fluorescent proteins has demonstrated that glia are dynamic cells and actively participate in neurotransmitter signalling. **Ricardo Scott** addresses the issue from the neuronal viewpoint, describing how visualization of activity in individual CNS synapses has helped resolve the mechanisms of use-dependent control of presynaptic Ca^{2+} signalling in grey matter neurons. Evidence that astroglia are integral cellular elements at grey matter synapses is introduced by **Frank Kirchhoff and Alex Verkhratsky**, who describe how transgenic mouse models facilitate brain analysis of glutamate-mediated communications between astroglia and neurons at CNS synapses. Astroglia not only sense neurotransmitters released at synapses by virtue of their NMDA- and AMPA-type receptors, but also release neurotransmitters and are thereby able to communicate back to neurons and influence synaptic activity. **Arthur Butt and colleagues** (Wigley et al.) introduce a novel population of NG2-glia, which are active at grey matter synapses, in addition to astroglia. Intriguingly, neurotransmitters are also released along white matter axons and these stimulate Ca^{2+} excitability in NG2-glia and astrocytes. The physiological functions of neuron-glial signalling are the focus of these three papers, but neurotransmitters are also important in CNS pathology, and this is the focus of papers by Chvatal, Fern and Matute. **Alexandr Chvatal** discusses the dramatic and dynamic changes in astroglial cell three-dimensional morphology visualized by imaging of living astrocytes in grey matter brain slices during osmotic stress and ischaemia. **Robert Fern** describes live cell imaging of white matter glia and shows that glutamate mediates the loss of astrocytes and myelin during ischaemia in CNS white matter. This theme is continued by **Carlos Matute**, who discusses the evidence that neurotransmitters mediate excitotoxic damage in white matter glia, and their roles in ischaemia and the demyelinating disease multilpe sclerosis. These articles demonstrate the diverse properties of glial cells. Thus, the ability to image neurons and glia in living brain slices allows us to study their integrated function, which is essential if we are to have a true understanding of nervous system physiology and pathology.

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